a fuller discussion of the comparative rates of these systems and the synthesis of the other acids will be discussed in a later paper). Because eicosanoic acid was undetected, it is probably present in exceedingly small amounts and has a very high fractional turnover rate. It is also possible that the saturate pool of eicosanoic acid remains attached to the enzyme system, and would, therefore, be undetectable using our techniques. The monounsaturated fatty acids were not synthesized by elongation of the shorter chain monounsaturates because these syntheses would result in Δ11 isomers, and oxidative cleavage would have yielded undecanedioic acid as the dicarboxylic acid product. The identification of monounsaturated acids as Δ9 isomers is consistent with previous work demonstrating that insects synthesize monounsaturates by direct desaturation of the corresponding saturates (Bade 1964, Sridhara and Bhat 1965), and that direct or "aerobic" desaturation results in Δ9 isomers (Scheuerbrandt and Bloch 1962).

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The Chromosomes of Nine Ant Species (Hymenoptera: Formicidae) from Taiwan, Republic of China[1]

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ABSTRACT

Chromosomes of the following 9 species of ants from Taiwan are reported: *Aenictus* sp., near *camposi* Wheeler & Chapman, n = 15; *Tetraponera allaborans* Walker, n = 16; *Aphaenogaster tipuna* Forel, 2n = 34; *Oligomyrmex sauteri* Forel, n = 18; *Xiphomyrmex* sp., 2n = 20; *Paratrechina longicornis* (Latreille), 2n = 16; *Pseudolasius* sp., near *emeryi* Forel, n = 14; *Camponotus* sp. (*variegatus* complex), 2n = 20; *Polyrhachis dives* F. Smith, n = 21 (karyotype formula n = 1M + 8SM + 1ST + 3A + 8T).

The study of ant chromosomes was formerly a rather difficult task. However, with the improved techniques of Imai (1966) and Crozier (1968), ants have proven to be more suitable for cytological studies than most other groups of Hymenoptera. During summer of 1969 we studied the chromosomes of 20 species of ants in Taiwan. However, because of the hot summer weather and delays in photographing the squash preparations, preparations of 11 species were lost and some of the photographs were not clear

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enough for karyotype analysis. The 9 species discussed hereinafter represent the 1st records of chromosomes for each species. In addition, 2 of the species represent 1st records for their subfamilies.

MATERIALS AND METHODS

Field-collected ants and their brood were held in the Entomology Laboratory of Chung Hsing University, Taichung, Taiwan, until the brood reached suitable stages. The organs used as sources of cytological material included the testes of male pupae at the "slight rouge" eye stage, the ovaries of female pupae at the "scarlet" eye stage, and the brains (cerebral ganglia) of all castes at the "transparent" prepupal stage. The organs were dissected out in hypotonic solution with colchicine (0.45% sodium citrate 10 ml:0.1% colchicine 1 ml). After tracheae and fat bodies were removed, the organs were transferred to the same hypotonic solution for 10–15 min at room temperature. Fixing and staining were made in aceto-orcein (1% orcein in 50% glacial acetic acid) for 30 min. After this treatment, the organs were transferred to precleaned slides with a small amount of aceto-orcein. Coverslips were placed over the organs, excess aceto-orcein was removed, and the material was squashed with the thumb between a piece of highly absorbent paper and a thick glass plate. Finally, the squash preparations were sealed with nail polish. Voucher specimens bearing collection numbers are deposited in the collections of Hung and Kubota.

RESULTS AND DISCUSSION

Dorylinae.—*Aenictus* sp., near *camposi* Wheeler & Chapman.—$n = 15$, 2 cells from testes of male pupae; $2n = 30$, 4 cells from brain of worker prepupae. One colony (no. 11) taken at Fenchihu (1800 m alt). Identified by W. L. Brown, Jr. This record is the first of chromosome number in this subfamily.

Pseudomyrminae.—*Tetraponera allaborans* Walker.—$n = 16$, 7 cells from testes of male pupae. One colony (no. 2) taken at Wufeng, Taichung. Identification confirmed by Dr. Brown. This record is also the first for the Pseudomyrminae.

Myrmicinae.—*Aphaenogaster tipuna* Forel.— $2n = 34$, 14 cells from brain of worker prepupae. One colony (no. 8) taken at Wushe (1500 m alt) and another (no. 14) at Fenchihu. Identified by Dr. Brown. Hauschteck (1962) reported $2n = 22$ for *A. subterranea* (Latreille) from Switzerland. The same number was found in *A. smythiesi* Forel from Japan (Imai 1971). Imai also reported haploid numbers of 16 and 17 for the other 2 Japanese species (*A. osimensis* Teranishi and *famelica* (F. Smith)) and suggested that the karyotype of *famelica* ($n = 17$) could be derived from that of *osimensis* ($n = 16$) by centric dissociation of the largest submetacentric chromosome. A karyotype variation of 16–18 was found in a North American species, *A. rudis* (Emery), suggesting rapid karyotype change relative to phenotype change (Crozier 1970).

Oligomyrmex sauteri Forel.—$n = 18$, 11 cells from testes of male pupae. One colony (no. 12) taken at Fenchihu. The cytology of *Oligomyrmex* has not previously been studied. The other species in the subfamily Myrmicinae so far known to have $n = 18$ are *Vollenhovia emeryi* Wheeler (Imai 1966) and *A. rudis* Emery ($n = 16–18$). The latter is in the tribe Pheidolini and according to Ettershank (1966) *Vollenhovia* is not a member of the *Pheidologeton* genus group to which *Oligomyrmex* belongs.

Xiphomyrmex sp.—$2n = 20$, 11 cells from brain of worker prepupae. One colony (no. 19) taken at Fenchihu. Identified by Dr. Brown. The only other species of the tribe Tetramoriini known cytologically are *Strongylognathus huberi alpina* Wheeler (Hauschteck 1962) and *Tetramorium caespitum* (L.) (Hauschteck 1961, Imai 1966). Each of the latter has $n = 14$.

Formicinae.—*Paratrechina longicornis* (Latreille). —$2n = 16$, 7 cells from ovaries of female pupae. One colony (no. 3) taken at Taichung. This well known tropicopolitan species has been placed in the genus *Prenolepis* by some authors. Because *Prenolepis imparis* Say is the only other species in the Lasiini so far known to have $2n = 16$ (Hauschteck 1962), a close relationship of *longicornis* to *Prenolepis* is evident. The other groups in this tribe the cytology of which has been examined are the genus *Lasius* with $n = 14$ or 15 (Crozier 1970, Hauschteck 1962, Hung 1969, Imai 1966) and *Pseudolasius* (see hereinafter).

Pseudolasius sp., near *emeryi* Forel.— $n = 14$, from testes of 20 ♂ pupae. One colony (no. 10) taken at Lusan (1420 m alt) near Wushe. This species has the same chromosome number as some species in *Lasius*. Although we lack data for the North American honey ant genus *Myrmecocystus* and the monotypic genus *Andragnathus* from Java, it now seems

Table 1.—Frequency of haploid and diploid cells observed in the testes, and of polyploid cells in male cerebral ganglia, of *Pseudolasius*.

	Range of ploidy			
Individuals observed	n	2n	4n	8n
	Testes			
1	139	2		
2	349	0		
3	400	1		
4	181	2		
5[a]	0	53		
6[a]	4	337		
7[a]	0	276		
8[a]	0	542		
	Cerebral ganglia			
1	33	12	7	5
2	85	42	3	4
3	29	10	8	7
4[b]	8	17	0	0
5	75	16	0	0
6	29	2	0	0
7	38	9	4	1

[a] Exceptional males having diploid number which are conveniently named as diploid males.

[b] Diploid cells predominate over haploid cells, suggesting a diploid male occurred secondarily by polyploidization.

evident that the tribe Lasiini is composed of 2 distinct groups as far as chromosome numbers are concerned; one with $n = 8$ and the other $n = 14–15$.

Polyploid cells have been observed in the larval somatic cells in ants (Smith and Peacock 1957, Hauschteck 1965). Imai and Yosida (1965) also found diploid and tetraploid cells in the testes and tetraploids in the oögonial cells of *A. osimensis*. In our study we have found 7 diploid and 20 haploid males in this species with many diploid cells, especially in the testes (Table 1). However, no gross morphological differences were found between these haploid and diploid males. Further studies are needed to determine whether the diploid males produce functional sperm or not. This information may be a key point in knowing whether polyploidization has played an important role in the karyotype evolution in ants as suggested by Imai (1966, 1969, 1971).

Camponotus sp., (*variegatus* complex).—$2n = 20$, 20 cells from brains of worker prepupae. One colony (no. 21) taken at Kenting Botanical Garden. Identified by Dr. Brown. *C. compressus* (F.) from India is the only other *Camponotus* known to have the same chromosome number (Kumbkarni 1965).

Polyrhachis dives F. Smith.—$n = 21$ (Fig. 1), 18 cells from testes of male pupae. One colony (no. 1) taken on the campus of Chung Hsing University. This large Old World genus with ca. 500 nominal forms is poorly known cytologically. Besides *P. dives*, only 4 other species have been studied: *hippomanes* F. Smith with $n = 20$ and *lamellidens* F. Smith with $2n = 42$ (Imai 1969), *simplex* Mayr with $2n = 42$, $n = 21$ (Imai, unpublished) and *rastellata* (Latreille) with $n = 21$ (Crozier 1970). Morphologically, *dives*, *hippomanes*, and *simplex* are in the same subgenus, *Myrmhopla*, while *rastellata* belongs to the subgenus *Cyrtomyrma* and *lamellidens* is in the subgenus *Polyrhachis*. Furthermore, *Myrmhopla* is more closely related to *Cyrtomyrma* than to *Polyrhachis* (s. str.) (Hung 1967). As shown in Fig. 1, *dives* has a karyotype formula of $n = 1M + 8SM + 1ST + 3A + 8T = 21$. A karyotype formula of $n = 11SM + 1ST + 8T = 20$ was reported for *hippomanes* (Imai 1969) and according to Crozier (1970), *rastellata* has 4 metacentrics and 17 subacrocentrics (= subtelocentric) to acrocentric (= telocentric + acrocentric) chromosomes. We do not know the centromere positions of chromosomes in the other 2 species. However, it is interesting to note that within the subgenus *Myrmhopla* there are at least 2 different chromosome numbers with significantly different karyotype formulas.

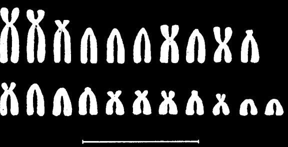

FIG. 1.—Karyotype of *P. dives*, $n = 21$, based on the study of 18 cells. (Scale line = 5 μ.)

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